

**SIXTH LONG-TERM SOIL VAPOR
SAMPLING RESULTS
DECEMBER 2000**

AT THE

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JET PROPULSION LABORATORY
PASADENA, CALIFORNIA**

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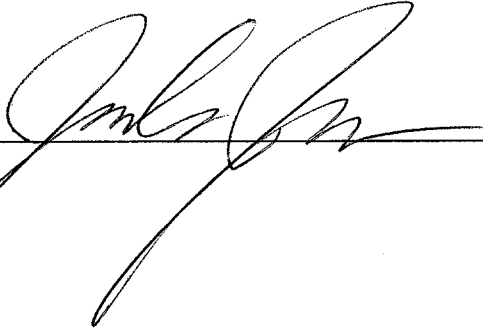
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1.0 INTRODUCTION

Presented in this report are the results of the sixth long-term soil vapor sampling event completed as part of the long-term monitoring program being conducted at the NASA-Jet Propulsion Laboratory (JPL) for Operable Unit 2 (OU-2) (contaminant source investigation). The purpose of this program is to monitor the horizontal and vertical distributions of volatile organic compound (VOC) vapors in the vadose zone beneath the JPL site. From December 18 through December 28, 2000, GEOFON, Inc. (GEOFON) personnel collected soil-vapor samples from the deep soil vapor monitoring well Nos. 25 through 28 and Nos. 32 through 39 at the locations shown in Figure 1-1.

All soil vapor samples collected during the event were analyzed for VOCs by HP Labs in an on-site laboratory that is certified by the California Department of Health Services (CDHS). The analyses were performed in accordance with EPA Method 8010/8020 and the California Regional Water Quality Control Board, Los Angeles Region (RWQCB), protocols and guidance.

Sampling procedures are described in Section 2.0, and a summary of all VOCs detected during this sixth long-term soil vapor sampling event, including locations and depths, is contained in Section 3.0. A soil vapor data validation report for all samples analyzed during this sampling event is located in Appendix A and summarized in Section 4.0. Cited references are listed in Section 5.0. Laboratory reports for all samples analyzed, along with chain-of-custody forms, are included in Appendix B. The initial three-point calibration data and the daily calibration verification standards for each day's sampling are also included in this appendix. Contained in Appendix C is a summary of soil-vapor results from all events conducted during the long-term monitoring program.

2.0 SOIL VAPOR SAMPLING PROCEDURES

From December 18 through December 28, 2000, soil-vapor samples were collected and analyzed from deep soil vapor monitoring well Nos. 25 through 28 and Nos. 32 through 39. A description of how the soil-vapor wells were constructed was presented in a previous report (FWENC, 2000a), and well construction details are summarized in Table 2-1. Sixty-eight (68) depth-specific vapor samples, including twelve (12) collocated duplicate samples were collected and analyzed for 25 primary target VOC compounds in accordance with the RWQCB (1997) guidance.

Soil-vapor samples were withdrawn from the soil through the sampling tips and 1/8-inch-outside diameter (OD) Nylaflow® tubing using calibrated, gas-tight, 60-cubic-centimeter (cc) sterile syringes fitted with a three-way on-off valve. Prior to collecting the soil-vapor sample, four volumes of the length of the tubing were purged to flush the tubing and fill it with in-situ soil vapor. Since each foot of tubing has an internal volume of 1 cc, the total volume purged was easily measured with the calibrated syringes. Following purging, a 60-cc soil-vapor sample was collected in the syringe, the valve turned to the off position, and transferred immediately to the on-site mobile laboratory for analysis. During sampling, neither water vapor nor condensation was observed in the transparent sampling syringes. Because the purge and sample volumes were small, a vacuum pump was not required to evacuate the tubing or to collect a soil-vapor sample. To demonstrate reproducibility of results, a duplicate soil-vapor sample was collected and analyzed after every five environmental samples.

Samples collected were analyzed on-site in a mobile laboratory certified (Certification No. 1745) by the CDHS to perform analyses by EPA Methods 8010 and 8020 for the parameters listed in Table 2-2. The time between sample collection and analysis was, at most, only a few minutes.

3.0 ANALYTICAL RESULTS

The results from the remedial investigation (RI) for OU-2 (FWENC, 1999) indicated that four VOCs were more frequently detected in soil-vapor samples at elevated concentrations relative to other VOCs. These four VOCs are carbon tetrachloride (CCl_4), 1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113), trichloroethene (TCE), and 1,1-dichloroethene (1,1-DCE). Carbon tetrachloride and Freon 113 were detected in most soil-vapor samples where VOCs were present, and were frequently the only VOCs present. Carbon tetrachloride was usually detected at higher concentrations than Freon 113.

The VOCs most frequently detected during this sixth long-term sampling event were, as in the past, CCl_4 , Freon 113, TCE, and 1,1-DCE. In general, concentrations measured during this event are lower than those measured during the prior sampling event (FWENC, 2000d). Furthermore, many concentrations measured during this event are substantially lower than those measured during the OU-2 RI. This sampling event was performed prior to restarting the SVE system on January 8, 2001.

Two other VOCs, chloroform and 1,1,1-trichloroethane (1,1,1-TCA), were also detected during this sampling event. Chloroform was detected in three soil-vapor wells (Nos. 33, 34 and 36), and 1,1,1-TCA was detected in one well (No 36). Trichlorofluoromethane (Freon 11), which had been detected in prior events, was not detected during this event. Concentrations of these compounds were generally low relative to those of other compounds detected [chloroform: 1.2 to 2.4 micrograms per liter of vapor ($\mu\text{g/L-vapor}$) and 1,1,1-TCA: 7.5 to 8.2 $\mu\text{g/L-vapor}$]. A summary of the analytical results for all samples collected during this sampling event is presented in Table 3-1, and the laboratory reports for each day's sampling are presented in Appendix B-1. Chain-of-custody forms are included in Appendix B-2. Data from all long-term monitoring events conducted to date are tabulated in Appendix C.

Locations of detections with depth for CCl_4 , Freon 113, TCE, and 1,1-DCE are shown in Figures 3-1, 3-2, 3-3, and 3-4, respectively. Total VOC concentrations with depth are presented in Figure 3-5. and the estimated horizontal and vertical distribution of total VOCs along a section through the north-central part of the site (where VOC concentrations were found to be the highest during the OU-2 RI) is presented in Figure 3-6.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

This section briefly summarizes the quality assurance and quality control (QA/QC) procedures followed during the sixth long-term soil vapor sampling event. A more thorough discussion on the QA/QC processes and data evaluation are presented in Appendix A, Soil Vapor Data Validation Report.

All sample analyses were performed using an external, three-point standard calibration method (Appendix B-3). [For most target analytes, both detectors on the gas chromatograph (GC) were calibrated over a range equivalent to 2 to 150 µg/L analyte in soil vapor.] Analytical system performance was verified at the beginning of each analytical day with an "opening standard" and a "closing standard" after the last environmental sample analysis for the day. A "continuing standard" was analyzed after the tenth environmental sample run that day. If ten or fewer samples were analyzed during the day, the closing standard substituted for the continuing standard. Results of the daily opening, closing, and continuing (if applicable) standards are presented in Appendix B-4.

During each analytical day, the environmental sample analyses were bracketed by check standards which verified acceptable system performance for the analytes listed in the daily calibration data summary tables (Appendix B-4). Response factors (RF) calculated from the opening standard results were within ± 15 percent of the mean calibration factors calculated from initial calibration results. Results for closing standards and continuing standards were within ± 20 percent of initial calibration results. Percent differences between analyte-specific response factors were always within applicable control limits.

Field blanks of ambient air from inside the field laboratory trailer were analyzed immediately after the opening verification standard and were clean in all cases. No matrix spikes or laboratory replicates were required.

Three surrogate compounds (1,4-difluorobenzene, chlorobenzene, and 4-bromofluorobenzene) were injected into the GC along with the environmental samples as a QA/QC check on recovery limits. In accordance with RWQCB (1997) protocols, surrogate recoveries should be in the range of 75 to 125 percent. All surrogate recoveries obtained during this sampling event satisfied this criteria by a wide margin, usually within a recovery range of 85 to 115 percent.

No sample analysis data obtained during this sampling event were rejected as unusable. Overall, the assessment of soil vapor and corresponding control sample data indicate that data quality objectives were achieved in terms of precision, accuracy, representativeness, comparability, and completeness for all analytes sampled.

5.0 REFERENCES

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